

CLAIM AMENDMENTS

1. (Original) A method for remotely monitoring and diagnosing operations of a machine, the method comprising:

detecting signals of one or more of the machine's operating and condition parameters;
comparing the detected signals to a signal model maintained locally with respect to the machine's location and identifying any anomalies in the detected signals compared to the signal model;

transmitting information describing each anomaly to a location remote from the machine;

diagnosing at the remote location the information describing the anomaly, where the diagnosis includes an initial analysis of the information by diagnostic tools maintained at the remote location, a subsequent analysis of the information by diagnostic tools maintained elsewhere if the initial analysis fails to provide a diagnosis and a final analysis by a team of humans aided by a collaborative environment if the initial and subsequent analyses fails to provide a diagnosis; and

reporting the diagnosis of the anomaly to a location capable of attending to repair of the machine.

2. (Original) The method for remotely monitoring and diagnosing operations of a machine as set forth in claim 1 wherein the step of detecting signals of machine operating and condition parameters includes continuously monitoring at least one of the operating parameters and the condition parameters.

3. (Original) The method for remotely monitoring and diagnosing operations of a machine as set forth in claim 1 wherein the signal model is a statistical model based on an initial collection of the detected signals.

4. (Original) The method for remotely monitoring and diagnosing operations of a machine as set forth in claim 1 wherein the detected signals are derived from a plurality of sensors, the method including the steps of :

identifying a failed sensor;

regenerating the signal model based on remaining sensors;

monitoring the machine based on the remaining sensors and the signal model until the failed sensor is repaired or replaced.

5. (Original) The method for remotely monitoring and diagnosing operations of a machine as set forth in claim 1 wherein the detected signals are derived from a plurality of sensors, the method including the step of generating a sensor replacement signal if the identified anomaly is based on a detected signal from a single sensor such that the replacement signal is substituted into the detected signals as a placement for the detected signal from the single sensor and the step of comparing includes the step of comparing the detected signals containing the replacement signal to the signal model.

6. (Original) The method for remotely monitoring and diagnosing operations of a machine as set forth in claim 1 including the step of adding the diagnosis to the diagnostic tools maintained at the remote location if the diagnosis is provided by one of the diagnostic tools maintained elsewhere and the team of humans.

7. (Original) A local tool positioned proximate a machine for providing an analysis of the machine's operating conditions, where the tool is connected via a communications link to a remote diagnostic tool that diagnoses an anomaly in the operation of the machine when requested by the local tool, the local tool comprising:

a plurality of sensors connected to the machine for generating information describing the operating condition of the machine;

a processor for receiving the information from the plurality of sensors, the processor including (1) a model of the information assuming normal operation of the machine, (2) instructions for analyzing the information from sensors with respect to the model and generating an exception report when the information from the plurality of sensors does not fit the model; and

an interface to the communications link for sending the exception report to the remote diagnostic tool for diagnosis.

8. (Original) The local tool of claim 7 wherein the processor includes a learning mode for generating a model of the normal operation of the machine.

9. (Original) The local tool of claim 8 wherein the local tool includes an interface for putting the processor in the learning mode.

10. (Original) The local tool of claim 8 wherein the interface is a reset button for putting the processor in the learning mode.

11. (Original) The local tool of claim 8 wherein the local tool includes a sensor conditioning module for performing signal conditioning on the information from the plurality of sensors.

12. (Original) A diagnostic tool located remotely from a machine that provides a diagnosis of an anomaly of the machine's operating conditions, where the diagnostic tool is connected via a communications link to a local tool that is located proximate the machine, and the local tool monitors the operating conditions of the machine and identifies the anomalies, the remote diagnostic tool comprising:

a first node on the communications link for diagnosing the anomaly detected by the local tool and instructions for diagnosing the anomaly using diagnostic tools available at the node;

additional nodes on the network having access to additional diagnostic tools;

an interface between the first node and the additional nodes for communicating the anomaly from the first node to the additional nodes; and

instructions at the first node for communicating the anomaly to one of the additional nodes if the diagnostic tools available at the first node are unable to provide a diagnosis of a cause of the anomaly.

13. (Original) The diagnostic tool of claim 12 wherein the local tool includes two distinctive types of pattern matching libraries.

14. (Original) The diagnostic tool of claim 13 wherein the two distinctive types of pattern matching libraries include libraries for matching systemic and component operating conditions.

15. (Original) The diagnostic tool of claim 12 where the instructions at the first node include instructions for communicating the anomaly to an expert system supported by human interaction for diagnosing the anomaly when the diagnostic tools of the first and additional nodes fail to provide a diagnosis.

16. (Original) A diagnostic tool located remotely from a machine that provides a diagnosis of an anomaly of the machine's operating conditions, where the diagnostic tool is connected via a communications link to a local tool that is located proximate the machine, and the local tool monitors operating conditions of the machine and identifies the anomalies, the remote diagnostic tool comprising:

a node on the communications link diagnosing the anomaly detected by the local tool;

diagnostic tools at the node including a first library of patterns comprising information describing systemic anomalies and a second library of patterns comprising information describing component anomalies; and

instructions at the node for diagnosing, using the first and second libraries in succession.

17. (Original) The diagnostic tool of claim 16 wherein the node is a first node and the communications link includes a second node that is connected to the first node and receives the anomaly from the first node when the first node fails to diagnose the anomaly, where the second node includes one or more human experts working in a collaborative environment to diagnose the cause of the anomaly.

18. (Original) The diagnostic tool of claim 17 wherein the communications link includes a third node that is connected to the first node and receives a diagnosis of the cause, where the third node includes one or more services capable of attending to repair of the machine.

19. (Original) The diagnostic tool of claim 17 wherein the communications link includes a fourth node that is connected to the first node and receives the anomaly from the first node when the first node fails to diagnose the anomaly, where the fourth node includes instructions for diagnosing the anomaly, and where the second node receives the anomaly from the first node if the fourth node fails to diagnose the anomaly.